

CLAIMS:

1. A valve actuator assembly for an engine comprising:

a movable engine valve;

a movable finger for contact with said engine valve;

a rotatable cam for contact with said finger;

and

a finger-support element assembly for contact with said finger comprising a first piston and a second piston, said first piston and said second piston being axially aligned and independently movable in the same direction to provide full lift of said engine valve in an activated mode and lost motion of said engine valve in a de-activated mode.

2. A valve actuator assembly as set forth in claim 1 wherein said finger-support element assembly includes a housing.

3. A valve actuator assembly as set forth in claim 2 wherein said housing includes a dividing wall forming a chamber therein.

4. A valve actuator assembly as set forth in claim 3 wherein said first piston comprises a head being disposed in said chamber and a shaft extending axially from said head and through an aperture in said dividing wall.

5. A valve actuator assembly as set forth in claim 4 wherein said finger-support element assembly includes a spring disposed in said housing and about said shaft between said head and said dividing wall to urge said head away from said dividing wall.

6. A valve actuator assembly as set forth in claim 3 wherein said second piston is partially disposed in said housing and extends axially through an aperture in said housing for contact with said finger.

7. A valve actuator assembly as set forth in claim 6 wherein said finger-support element assembly includes a spring disposed in said housing between said dividing wall and said second piston to urge said second piston away from said dividing wall.

8. A valve actuator assembly as set forth in claim 2 wherein said first piston and said housing share a common interface that has a sufficiently small

clearance to control leak-down of high-pressure fluid supporting said first piston in an engine valve fully-active mode.

9. A valve actuator assembly as set forth in claim 2 wherein said second piston and said housing share a common interface that has a sufficiently large clearance to enable high-speed reciprocating motion of said second piston without significant drag losses when said engine valve is not fully active.

10. A valve actuator assembly as set forth in claim 3 wherein said second piston has a hollow shaft extending axially from a head of said second piston and receives a shaft of said first piston extending through an aperture of said dividing wall, thereby providing structural stiffness against side loading of said second piston.

11. A valve actuator assembly as set forth in claim 1 including a control valve fluidly communicating with said first piston of said finger-support element assembly and a fluid source.

12. A valve actuator assembly as set forth in claim 11 including a first one-way flow valve

fluidly communicating with said control valve and the fluid source, and hydraulically enabling displacement of said first piston in a direction to contact and support said second piston, and also preventing the displacement of said first piston away from contacting and supporting said second piston when the engine valve is fully active.

13. A valve actuator assembly as set forth in claim 1 wherein said second piston has a lubricant channel extending therethrough to provide a lubricant flow to the contact between said finger and said second piston.

14. A valve actuator assembly as set forth in claim 13 including a second one-way flow valve fluidly communicating with said lubricant channel of second piston of said finger-support element assembly, permitting the filling of a damping chamber when said first and second pistons are apart from each other.

15. A valve actuator assembly as set forth in claim 14 wherein said second one-way flow valve prevents flow out of the damping chamber when a tip of said first piston plunges into the damping chamber on said second piston, providing soft landing of said

second piston on said first piston, thereby enabling a secondary lift of said engine valve with partial lost motion.

16. A valve actuator assembly comprising:
a movable engine valve;
a movable finger for contact with said engine valve;
a rotatable cam for contact with said finger;
and
a finger-support element assembly for contact with said finger comprising a housing, a first piston disposed in said housing, a second piston being partially disposed in said housing and axially aligned with said first piston, a first spring disposed in said housing to urge said first piston away from said second piston, and a second spring disposed in said housing to urge said second piston into contact with said rocker arm, said first piston and said second piston being independently movable in the same direction to provide lift of said engine valve in an activated mode and lost motion of said engine valve in a de-activated mode.

17. A valve actuator assembly as set forth in claim 16 wherein said housing includes a dividing wall forming a chamber therein.

18. A valve actuator assembly as set forth in claim 17 wherein said first piston comprises a head being disposed in said chamber and a shaft extending axially from said head and through an aperture in said dividing wall.

19. A valve actuator assembly as set forth in claim 18 wherein said first spring is disposed about said shaft between said head and said dividing wall to urge said head away from said dividing wall.

20. A valve actuator assembly as set forth in claim 16 wherein said second piston extends axially through an aperture in said housing for contact with said finger and said second spring is disposed between said dividing wall and said second piston to urge said second piston away from said dividing wall.

21. A valve actuator assembly as set forth in claim 16 including a control valve fluidly communicating with said first piston of said finger-support element assembly and a fluid source.

22. A valve actuator assembly as set forth in claim 21 including a first one-way flow valve fluidly communicating with said control valve and the

fluid source, and hydraulically enabling displacement of said first piston in a direction to contact and support said second piston, and also preventing the displacement of said first piston away from contacting and supporting said second piston when the engine valve is fully active.

23. A valve actuator assembly as set forth in claim 16 wherein said second piston has a lubricant channel extending therethrough to provide a lubricant flow to the contact between said finger and said second piston.

24. A valve actuator assembly as set forth in claim 23 including a second one-way flow valve fluidly communicating with said lubricant channel of second piston of said finger-support element assembly, permitting the filling of a damping chamber when said first and second pistons are apart from each other.

25. A valve actuator assembly as set forth in claim 24 wherein said second one-way flow valve prevents flow out of the damping chamber when a tip of said first piston plunges into the damping chamber on said second piston, providing soft landing of said second piston on said first piston, thereby enabling a

secondary lift of said engine valve with partial lost motion.

26. A valve actuator assembly as set forth in claim 16 wherein said first piston and said housing share a common interface that has a sufficiently small clearance to control leak-down of high-pressure fluid supporting the said first piston in an engine valve fully-active mode.

27. A valve actuator assembly as set forth in claim 16 wherein said second piston and said housing share a common interface that has a sufficiently large clearance to enable high-speed reciprocating motion of said second piston without significant drag losses when the engine valve is not fully active.

28. A valve actuator assembly as set forth in claim 17 wherein said dividing wall provides a common ground support for said first spring and said second spring enabling said first spring to be sufficiently soft and compressible at low fluid pressures, and enabling said second spring to be sufficiently stiff controlling valve train stiffness when the engine valve is not fully active.

29. A valve actuator assembly as set forth in claim 17 wherein said second piston has a hollow shaft extending axially from a head of said second piston and receives a shaft of said first piston extending through an aperture of said dividing wall, thereby providing structural stiffness against side loading of said second piston.

30. A valve actuator assembly as set forth in claim 16 wherein said first piston has a first head and said second piston has a second head, said first head and said second head both including a hollow section formed concentrically around their respective shafts to house a compressed thickness of said first and second springs, respectively.